Proceedings of the Workshop on
"Electric Utilities and Water: Emerging Issues and R&D Needs"

July 23-24, 2002
Pittsburgh Airport Hyatt Hotel
Pittsburgh, Pennsylvania

Sponsored by
U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Proceedings from
Workshop on Electric Utilities and Water: Emerging Issues and R&D Needs
Pittsburgh, PA

July 23-24, 2002

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Electricity production requires a reliable, abundant, and predictable source of water, a resource that is, increasingly, in limited supply in parts of the United States and much of the world. The electricity industry is second only to agriculture as the largest domestic user of water, accounting for 39% of all freshwater withdrawals in the nation, of which 74% is used in fossil-fuel-based electricity generation.[1] Coal, the most abundant fossil fuel, currently accounts for 52% of U.S. electricity generation[2], and each kWh generated from coal requires up to 27 gallons of water to produce. That means that U.S. citizens may indirectly depend upon as much water turning on the lights and running appliances as they may directly use taking showers and watering lawns.

As a growing economy drives the need for more electricity, so will it increase pressure on currently available water resources. The demand for water by the electric-utility sector will increasingly compete with demands from other sectors of the economy. As such, the availability of adequate supplies of water to produce electricity and the impact of power plant operations on water quality are receiving increased attention.

In response, the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) sponsored a workshop entitled *"Electric Utilities and Water: Emerging Issues and R&D Needs."* The workshop was co-sponsored by Los Alamos National Laboratory (LANL) and Sandia National Laboratory (SNL), and was held July 23-24, 2002 in Pittsburgh, PA. The purpose was to provide a forum for discussion of current and emerging issues related to the intimate tie between water and electricity generation and to help identify R&D needs and potential opportunities for private-public research partnerships. The workshop was the second in a series of workshops sponsored by LANL, NETL, and SNL intended to garner stakeholder input on relevant issues to be resolved in order to continue to provide the Nation with a sustainable supply of clean, affordable energy and water. The first workshop was held in Denver, CO on June 11-12, 2002.

The one-and-a-half day workshop brought together fifty-five (55) representatives from Federal and state government, the utility and coal industries, equipment manufacturers, national laboratories, academia, and regulatory agencies. Workshop presentations and breakout groups addressed a broad spectrum of topics including advances in cooling technology, development of alternative ("non-traditional") water sources, better understanding of power plant-watershed interrelationships, integrated water use planning, and the development of accurate science-based tools for future regulatory decision making.

As a result of the workshop and continuing dialogue with industry and other key stakeholders, NETL, as part of a larger three Laboratory energy-water RD&D initiative, will issue a competitive solicitation in Fiscal Year 2003 to begin to address emerging electric-utility and water issues.

---

[1] United States Geological Survey, ***Estimated Use of Water in the United States in 1995,*** U.S. Geological Survey Circular 1200, 1998.

[2] Energy Information Administration, ***Annual Energy Outlook 2002 With Projections to 2020***, DOE/EIA-0383(2002), December 2001.

WORKSHOP SUMMARY

INTRODUCTION

The U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) sponsored a workshop *on "Electric Utilities and Water: Emerging Issues and R&D Needs."* The workshop was cosponsored by Los Alamos National Laboratory (LANL) and Sandia National Laboratory (Sandia), and was held July 23-24, 2002 in Pittsburgh, PA. The purpose of the workshop was to provide a forum for discussion of current and emerging issues specifically focused on the intimate tie between water and electricity generation in the United States.

The workshop is the second in a series of workshops intended to garner stakeholder input on relevant issues that need to be resolved in order to continue to provide the Nation with a sustainable supply of clean, affordable energy and water. The first workshop was held in Denver, CO on June 11-12, 2002. The June workshop addressed the interdependencies between water and energy and potential implications for the U.S. from an economic growth and national security standpoint. Participants of the first workshop included representatives from State and Federal government, the oil and gas industry and coal-bed-methane producers, along with representatives from LANL, NETL, and Sandia.

The issues, priorities, and recommendations from the two workshops, as well as workshops that will follow, will serve to help to better define a national energy and water research, development, and demonstration (RD&D) strategy.

BACKGROUND

Electricity production requires a reliable, abundant, and predictable source of water, a resource that is, increasingly, in limited supply in parts of the United States and much of the world. The electricity industry is second only to agriculture as the largest domestic user of water, accounting for 39% of all freshwater withdrawals in the nation, of which 74% is used in fossil-fuel-based electricity generation. According to the U.S. Geological Survey, thermoelectric power plants used an estimated 190 billion gallons per day in 1995, accounting for 39 percent of freshwater withdrawals for all off-stream (public supply, domestic, commercial, irrigation, livestock, industrial, mining, and thermoelectric power) categories, and 47 percent of combined fresh and saline withdrawals. Fossil-fuel plants account for about 71 percent of thermoelectric power withdrawals, with more than 99 percent coming from surface waters. [1]

Coal, the most abundant fossil fuel, currently accounts for 52% of U.S. electricity generation[2], and each kWh generated from coal requires up to 27 gallons of water to

[1] United States Geological Survey, ***Estimated Use of Water in the United States in 1995,*** U.S. Geological Survey Circular 1200, 1998.
[2] Energy Information Administration, ***Annual Energy Outlook 2002 With Projections to 2020***, DOE/EIA-0383(2002), December 2001.

produce. That means that U.S. citizens may indirectly depend upon as much water turning on the lights and running appliances as they may directly use taking showers and watering lawns. As our Nation's growing economy drives the need for more electricity, so will it increase pressure on currently available water resources. The demand for water by the electric-utility sector will increasingly compete with demands from other sectors of the economy. As such, the availability of adequate supplies of water to produce electricity and the impact of power plant operations on water quality are receiving increased attention.

Two events covered in the popular press that occurred in late July highlighted the timeliness of the *"Electric Utilities and Water: Emerging Issues and R&D Needs"* workshop. The first concerned the possibility that several power plant projects along the Idaho and Montana border might be denied permits based on inter-state water availability issues. A second article discussed a recent U.S. Environmental Protection Agency decision that would require a Massachusetts power plant to significantly reduce the water it used for cooling to address impacts on aquatic organisms.

Since the workshop, there have been several additional news releases pertaining to water and electric utility power plants as summarized below:

- "Fate of Idaho Plants May Impact Sumas 2 Power Plant", *Puget Sound Business Journal*, Seattle, WA, July 26, 2002
- "Generating Plant to Put Recycled Water to Use", *Inland Valley Daily Bulletin*, Ontario, CA, August 26, 2002
- "Duke Power Warns Towns in Charlotte Area to Cut Water Use", *The Charlotte Observer*, Charlotte, NC, August 28, 2002
- "Water at Pueblo, CO, Power Plant Slows to Trickle", *The Pueblo Chieftain*, Pueblo, CO, August 29, 2002
- "Company Ends Fight for Power Generator on NJ-NY Border", *The Record*, Hackensack, NJ, September 5, 2002

WORKSHOP OUTLINE

The one-and-a-half day workshop brought together fifty-five (55) representatives from Federal and state government, the utility and coal industries, equipment manufacturers, national laboratories, academia, and regulatory agencies. The objective of the workshop was to discuss emerging water issues affecting electric utilities and to identify key R&D needs and opportunities for public-private research partnerships. Both formal presentations and more informal breakout group sessions were used to achieve this objective.

Speakers at the workshop included individuals from government research, energy planning, consulting, and regulatory organizations. The keynote speaker was Mr. David

E. Hess, Secretary of the Pennsylvania Department of Environmental Protection who spoke to balancing water resources and needs. Rita A. Bajura, Director of NETL, presented an overview of water-related topics impacting energy production and utilization including power plant cooling, produced waters from coal-bed methane, carbon sequestration, and the mapping and control of acid mine discharge. John Veil, Manager of Water Policy Program at Argonne National Laboratory outlined current and future water issues affecting fossil-fuel-based power industry. EPRI's water and sustainable research initiative was summarized by William M. Smith, Manager of EPRI's Market Driven Demand Response group. Gerold R. Hill, Senior Technical Advisor of the Southern States Energy Board, provided the southern states' perspective on the relationship between water and energy. Daniel Macuga of LANL presented a briefing on the results of the June 11-12 Denver workshop. Wayne C. Micheletti, Consultant, discussed needs for advancements in power plant cooling technology. Finally, Terry E. Ackman, Team Leader, provided a summary of NETL's remote sensing and acid mine discharge remediation research activities. The presentations served as a stimulus to the afternoon breakout sessions.

BREAKOUT SESSIONS

Two parallel breakout sessions were held in the afternoon of the first day to further discuss specific topics applicable to water and electric utility (power plant) siting and operations. The five general topic areas included:

- Cooling water and other process water needs
- Effluent and water-quality-impact issues
- Water-related permitting and siting issues
- Research and development needs and opportunities
- Related issues

The process used for the breakout sessions included a group discussion of each topic, intended to elicit the perspectives of the group participants. Throughout the dialogue, discussion points were transcribed so that they could be subsequently prioritized based on individual votes. Once the topics were covered, individuals were given an opportunity to add to the record topics or issues that had not been covered but were germane to the subject matter. Finally, all participants were ask to vote on what they felt were the issues of highest priority. For each breakout session, a presentation was then developed based on the most significant issues covered by the group. The presentations were delivered by a representative from each group during the next day's session for further discussion.

The two breakout groups identified a number of R&D needs related to the general topic areas:

- **Advanced Cooling Systems and Related Technology:** Options such as dry cooling, hybrid systems, and novel approaches that reduce water use and/or consumption, minimize impacts on overall power plant efficiency (e.g., derating), and that are cost competitive with current technology. Novel cooling systems, such as hybrid cooling,

series wet-dry, and even exotic systems such as ocean cooling or cryogenic cooling, may prove useful in meeting future water needs. Also includes advanced cooling water intake structures to protect against impingement and entrainment. Evaluate potential beneficial use for discharge waters (e.g., waste heat for aquaculture or process heating, discharge of water to man-made reservoirs for recreational use).

- **Alternative Water Sources:** Options for power plants to utilize alternative water sources, such as "gray" water, coal-bed methane produced waters, and underground mine pool water, that would serve to reduce the demand on limited fresh surface and ground water resources. Research to better characterize alternative water sources in terms of water quality and availability. Advanced water treatment technologies to allow for the cost-competitive use of non-traditional waters. Evaluation and assessment of the environmental implications of treating, using, and discharging alternative water.

- **Power Plant–Watershed Interrelationships:** Better understanding of the impacts of non-point source discharges such as atmospheric deposition on water quality and the relationship among the hydrological cycle, climate change, and water availability.

- **Integrated Water Use Planning:** Effective upstream/downstream user integration, for example the coordination of power plants and municipal waste water treatment plants to facilitate optimal utilization of limited resources. Development of watershed predictive tools to aid in water use planning and regulatory development, including issues relevant to proposed trading under the TMDL program.

- **Future Regulatory Issues:** Upcoming regulatory developments, such as the Clean Water Act's §316(b) regulations for new and existing facilities and Total Maximum Daily Load (TMDL) trading program that may impact on the siting and design of new plants as well as on the operation of existing plants.

A more detailed summary of the results of the two breakout sessions can be found in the Appendices. For further information on NETL's electric utilities and water research plans, please contact:

Thomas J. Feeley, III
Product Manager
Environmental and Water Resources Program
412.386.6134
feeley@netl.doe.gov

OR

Visit NETL's Environmental & Water Resources Website at:

http://www.netl.doe.gov/coalpower/environment/